19CH101– ENGINEERING CHEMISTRY

Unit-3 NANOCHEMISTRY

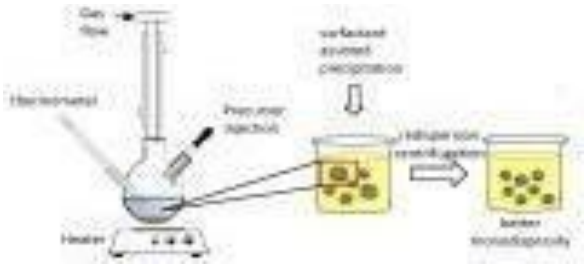
PREPARATION OF NANOMATERIALS

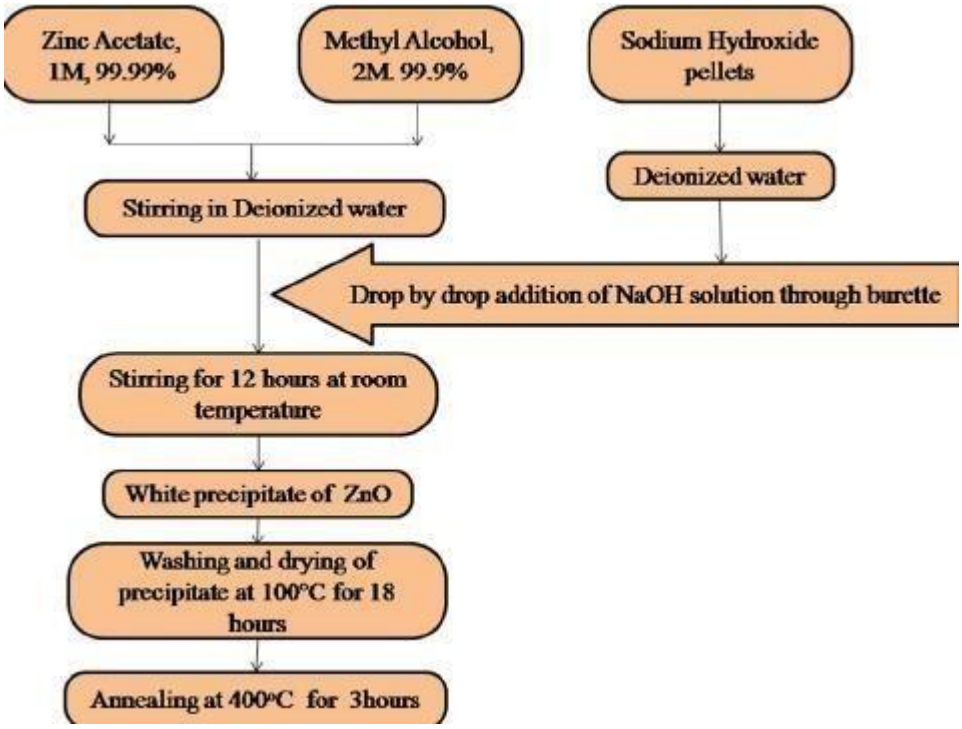
Preparation of $BaSO_4$ Nanoparticles

Nanoparticles of barium sulphate ($BaSO_4$) have been synthesized from barium nitrate by precipitation method in the presence of water soluble organic polycarboxylic polymer as a modifying agent.

50 mL 0.1 M $Ba(NO_3)_2$ was added to 50 mL 0.1M $(MH_4)_2SO_4$ in the presence of water soluble organic polymers as modifier agent. The solution was added drogpwise into the flask while stirring at room temperature with dispersant at strong mechanical stirring 2000-2500 rpm.

The steady drop rate was 20 drops min-1. Gelatinous white precipitates were formed instantly. The precipitates were separated from the mother liquid by centrifuged at 3000 rpm for 20 min. and then the supernatant solution was discharged and the solid was redispersed in deionized water. This process was repeated three times in order to rinse the particles. After the last centrifugation, sedimented particles were dried in the microwave oven. The products were slightly grinded for analysis.





SOL-GEL PROCESS

Sol-gel process The sol-gel process, involves the evolution of inorganic networks through the formation of a colloidal suspension (sol) and gelation of the sol to form a network in a continuous liquid phase (gel). The precursors for synthesizing these colloids consist usually of a metal or metalloid element surrounded by various reactive ligands. The starting material is processed to form a dispersible oxide and forms a sol in contact with water or dilute acid. Removal of the liquid from the sol yields the gel, and the sol/gel transition controls the particle size and shape. Calcination of the gel produces the oxide. Sol-gel processing refers to the hydrolysis and condensation of alkoxide-based precursors such as Si(OEt)4. The reactions involved in the sol-gel chemistry based on the hydrolysis and condensation of metal alkoxides can be described as follows:

$$MOR + H2O \rightarrow MOH + ROH \text{ (hydrolysis)}$$

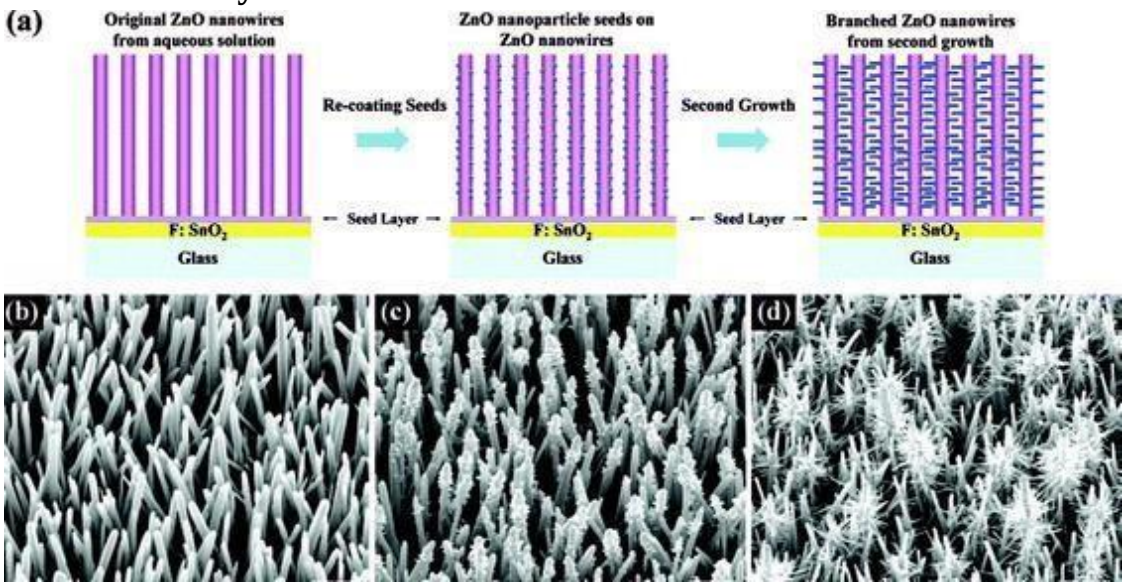
$$MOH + ROM \rightarrow M\text{-}O\text{-}M + ROH \text{ (condensation)}$$

Sol-gel method of synthesizing nanomaterials is very popular and is widely employed to prepare oxide materials.

Solvothermal synthesis

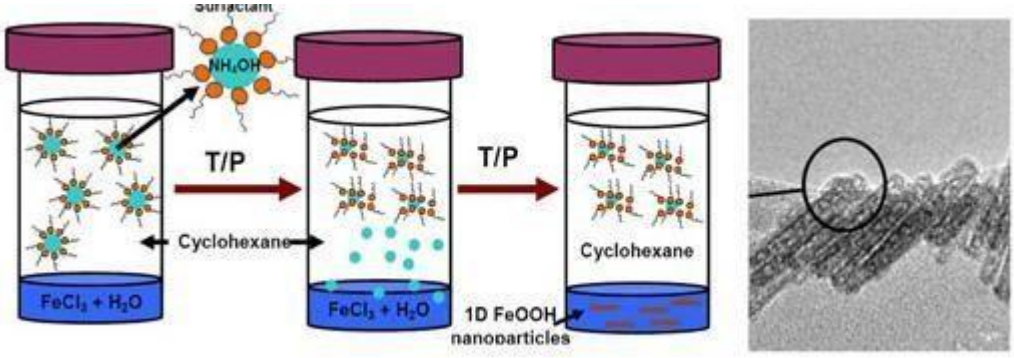
Solvothermal synthesis is a method for preparing a variety of materials such as metals, semiconductors, ceramics, and polymers. The process involves the use of a solvent under moderate to high pressure (typically between 1 atm and 10,000 atm) and temperature (typically between 100 °C and 1000 °C) that facilitates the interaction of precursors during synthesis.

Solvothermal synthesis of zinc oxide



Zinc acetate dihydrate is dissolved in 2-propanel at 50^{o} C. Then the solution is cooled to 0^{o} C and NaOH is added to precipitate ZnO. Then the solution is heated to

65^{o} C to allow ZnO growth for some period of time before a capping agent (1-dodecanethiol) is injected into the suspension to arrest the growth. The rod shaped ZnO nanocrystal is obtained.



Uses

This method can be used to prepare thermodynamically stable novel materials.